

The Design and Construction of a High Strain Asphalt Crack Relief Interlayer in NB

Nova Scotia User Producer Association

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Reflective cracking of asphalt pavement overlays is an ongoing complex problem to solve for roadway owners across Canada.

This can be especially challenging if you are working on an overlay on a concrete pavement, or deep asphalt pavement, where the high strain movements of underlying concrete or asphalt slabs will quickly crack the asphalt overlay, typical after the first winter.

The maintenance and repair of highway sections constructed with these composite pavements (i.e., asphalt over concrete) is complex and expensive due to the movement of the underlying slabs and the resultant reflective cracks due to the mismatch of rigid concrete and flexible asphalt.



The development of engineered asphalt interlayers in the 1990's to control the reflective cracking of these composite pavements focused on the use of unique, highly polymer modified asphalt binders with fine aggregate mixes.

These mixes were designed with high asphalt cement content (>8%) and low air voids (1.0 - 2.5%) and that was placed in a single 25mm lift to form a crack dampening layer.

In 2019, aromatic polyamide (aramid) was introduced to the asphalt interlayer as a suitable material to reinforce the asphalt interlayer.

The development of the balanced mix design (BMD) philosophy based upon performance tests for low-level rutting, and extreme cracking resistance resulted in the development of an engineered asphalt interlayer similar in performance to the original 1990's interlayers, but utilizing an only slightly modified asphalt cement binder and aramid reinforcement.

Aramid Reinforced Interlayer in Laboratory

- 25mm thick
- PG64-34 or PG58-34
- 130 g/t aramid fibre
- AC Content - >8.0%
- 38mm fibre length



Technical papers for TAC and CTAA conferences have been written on HSAI

Mix Design Characteristics for HSAI

Gradation	
Sieve	% Passing
3/8" (9.5 mm)	100
No. 4 (4.75)	80 - 100
No. 8 (2.36)	60 - 85
No. 16 (1.18 mm)	40 - 70
No. 30 (600 μm)	25 - 55
No. 50 (300 μm)	15 - 35
No. 100 (150 μm)	8 - 20
No. 200 (75 μm)	6 - 14
Volumetrics (N _{design} = 50 gyrations)	
Asphalt Content (Pb)	7.0 - 10.0%
Air Voids (AV)	2.0%
Voids in Mineral Aggregate (VMA)	16.0% min
Voids Filled with Asphalt (VFA)	70 - 95%

Aramid Reinforced Interlayer in Laboratory

Test	Proposed Criteria
Asphalt Binder, %	7.5 minimum
Air Voids, %	0.5 - 2.5
Voids in the Mineral Aggregate (VMA)	16.0 min.
*Cracking Resistance Testing:	
IDEAL-CT at 15°C	600 minimum
Semi-Circular Bend (SCB) at 25 °C	50 minimum
Disk-shaped Compact Tension (DCT) at -24 °C	800 minimum
*Rutting Resistance Testing	
Hamburg Wheel Tracking (HWT) at 45°C	5,000 passes minimum

*Samples for Cracking and Rutting Resistance specimens should be made at $3 \pm 0.5\%$ air voids.

Aramid dosage is a function of Climate (PG Grade)

Overlay thickness is based upon 20-year ESAL Design

HSAI in Canada

AB Transportation Hwy 16 Sherwood Park

- ✓ 2km Section
- ✓ Over chemically stabilized soils
- ✓ Construction 2024

MTO 2023-4030 Hwy 401 Napanee ON

- ✓ Composite Pavement
- ✓ BMD using IFIT, SCB, DCT, Hamburg, Beam Fatigue
- ✓ Paving 2024 and 2025

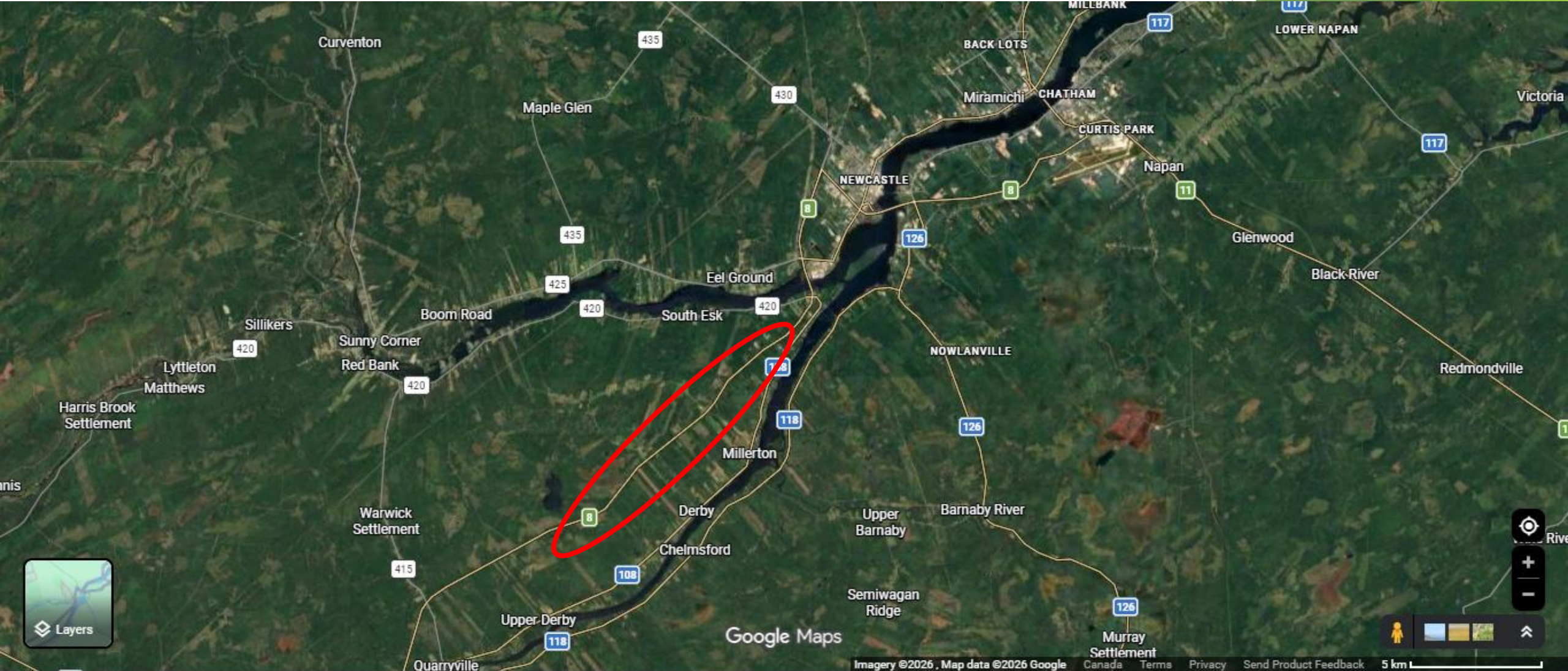
NB DTI Route 8 Miramichi

- ✓ 6.7km, 2-lane asphalt overlay on 38-year-old concrete pavement
- ✓ BMD using IDEAL CT, Hamburg
- ✓ Contract awarded to Eurovia Maritimes (Northern Contracting)
- ✓ Construction 2024

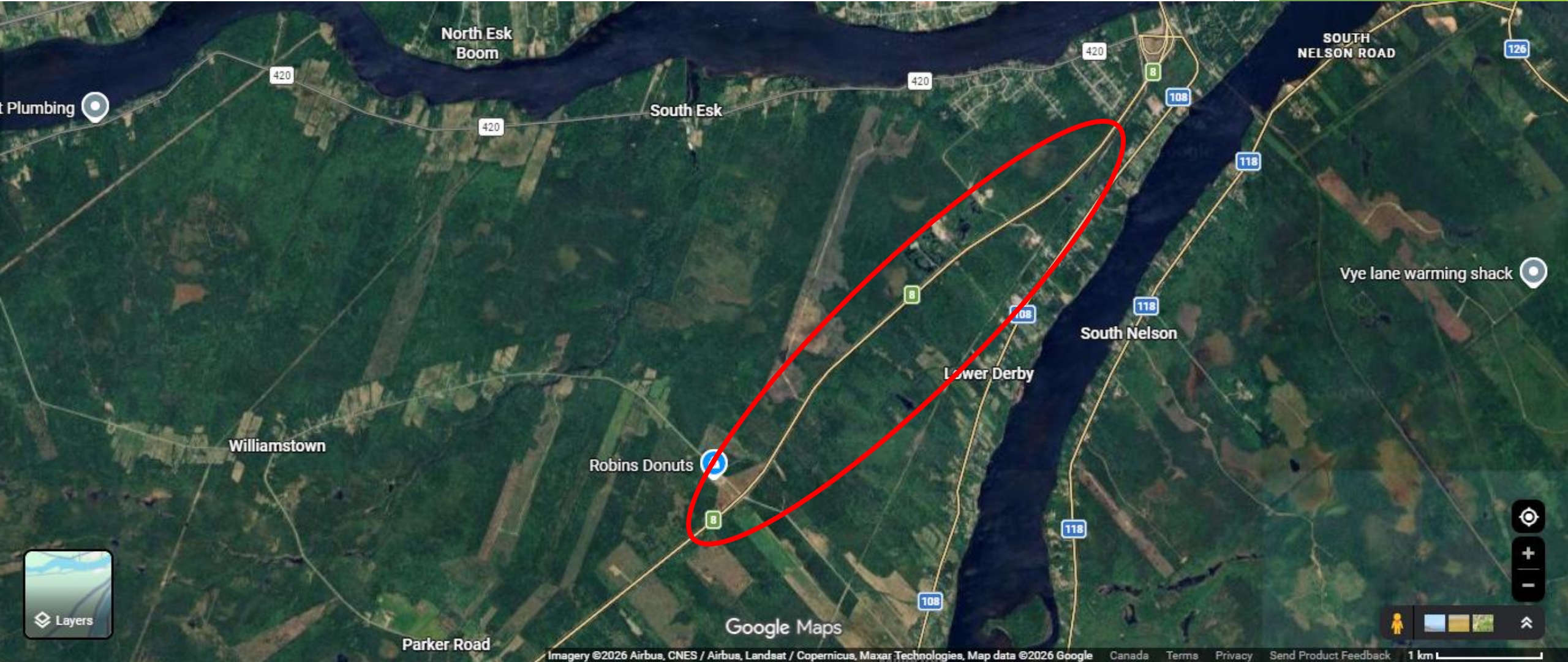
New Brunswick

- ▶ NB DTI using ARCA since 2022
- ▶ Multiple projects throughout NB
- ▶ Conducting performance testing on mixes w/ UNB
- ▶ Very pleased w/ performance to date

NB Rte 8



NB Rte 8



Route 8 Williamstown Road Area toward Route 420

CS 14, 2.100 to 8.131

\$7M budget for 2024

3 Options:

- Rubblization
- Remove/Recycle
- Flexible Interlayer



Source: Route 8 Concrete Highway Rehab Options – M. Sweezie Nov 2023



Rubblization

Estimate: Unknown

Pros:

- Reuse in place material
- Minimizes hauling/waste
- New pavement structure
- Sustainable
- Quick

Cons:

- No local contractor
- Likely require a detour
- Unknown mobilization cost



Flexible interlayer

Estimate: \$6.4M

Pros:

- Local Contractor & Materials
- Existing materials are left in place
- Minimal impact to traffic
- Sustainable
- Within Budget

Cons:

- Relatively new
- Unknown life expectancy



Remove & Recycle

Estimate: \$12M

Pros:

- Reuse existing materials
- Local Contractors & Equipment
- New pavement structure

Cons:

- Time consuming
- Likely require a detour via Route 108
- Extra hauling, GHGs
- Cost

Source: Route 8 Concrete Highway Rehab Options – M. Sweezie Nov 2023

Recommendation

Flexible Interlayer Option

- Within budget
- Surface Tech onsite in fall of 2023 – Viable option
- Utilizes existing materials for added strength
- Minimal impact to the public
- Locally sourced materials and local contractors
 - Mix is engineered for performance
- Technical support of Surface Tech, BATT & VA Asphalt Paving Technologies
- Ontario and Alberta both tendering work for 2024
- Sustainable approach

Source: Route 8 Concrete Highway Rehab Options – M. Sweezie Nov 2023

NB Rte 8



NB Rte 8



Google Maps

NB Rte 8



NB DTI Route 8



NB DTI Route 8

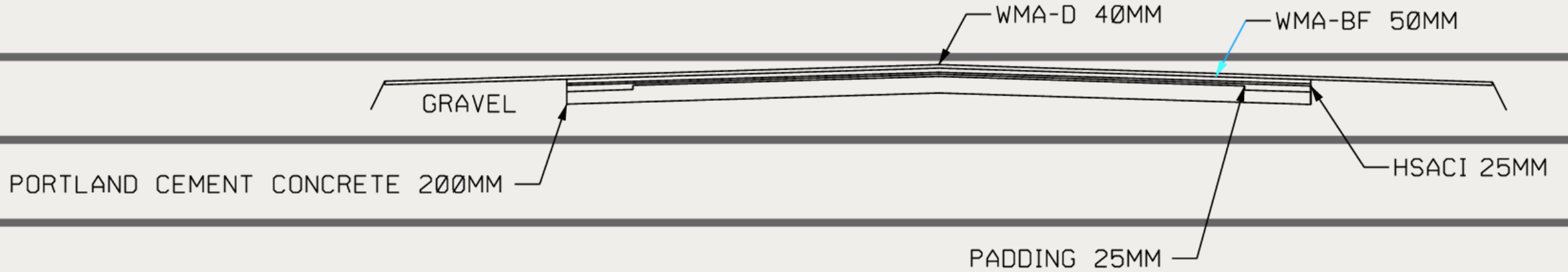


Aramid Fibre



38mm aramid to ASTM D8395-23

NB DTI Route 8



Interlayer 3,720 tonnes 130g/t Aramid Reinforced, 38mm

WMA – BF 7,340 tonnes 65g/t Aramid Reinforced, 38mm

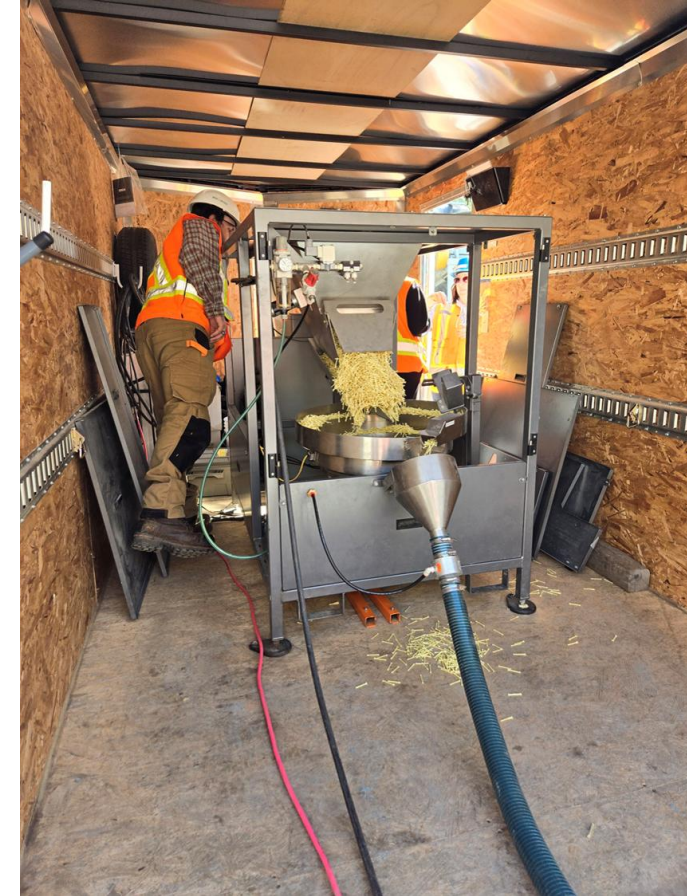
Leveling Pad



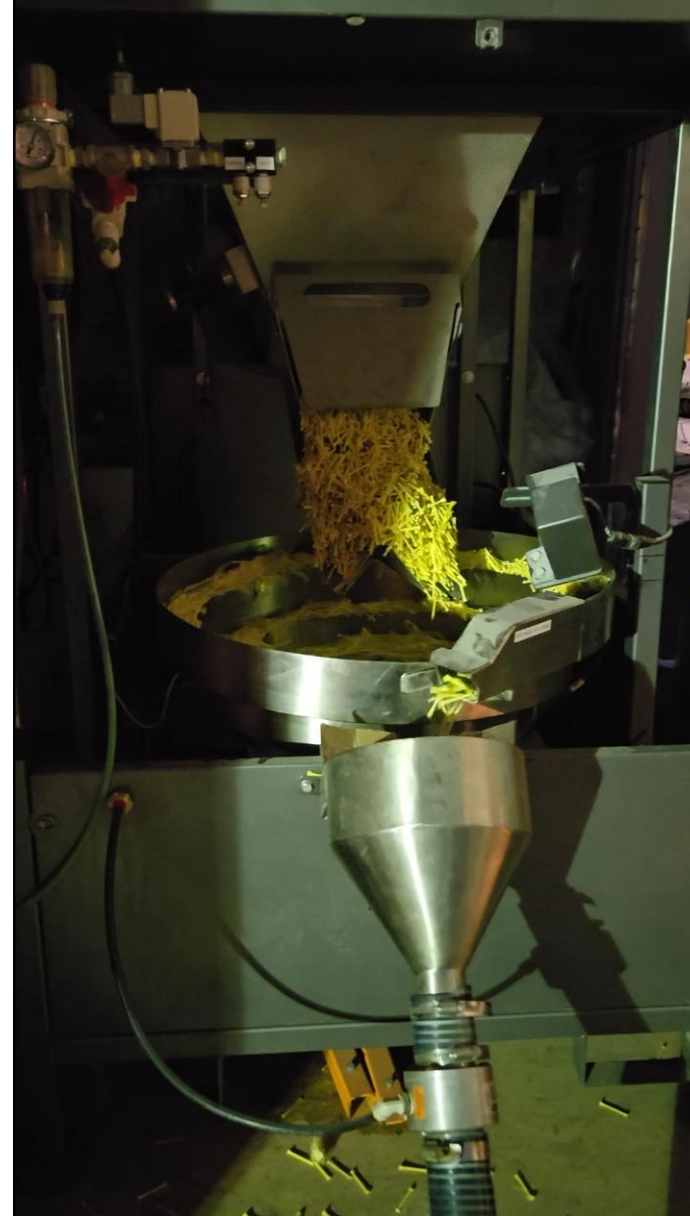
Test Section Prior to Production



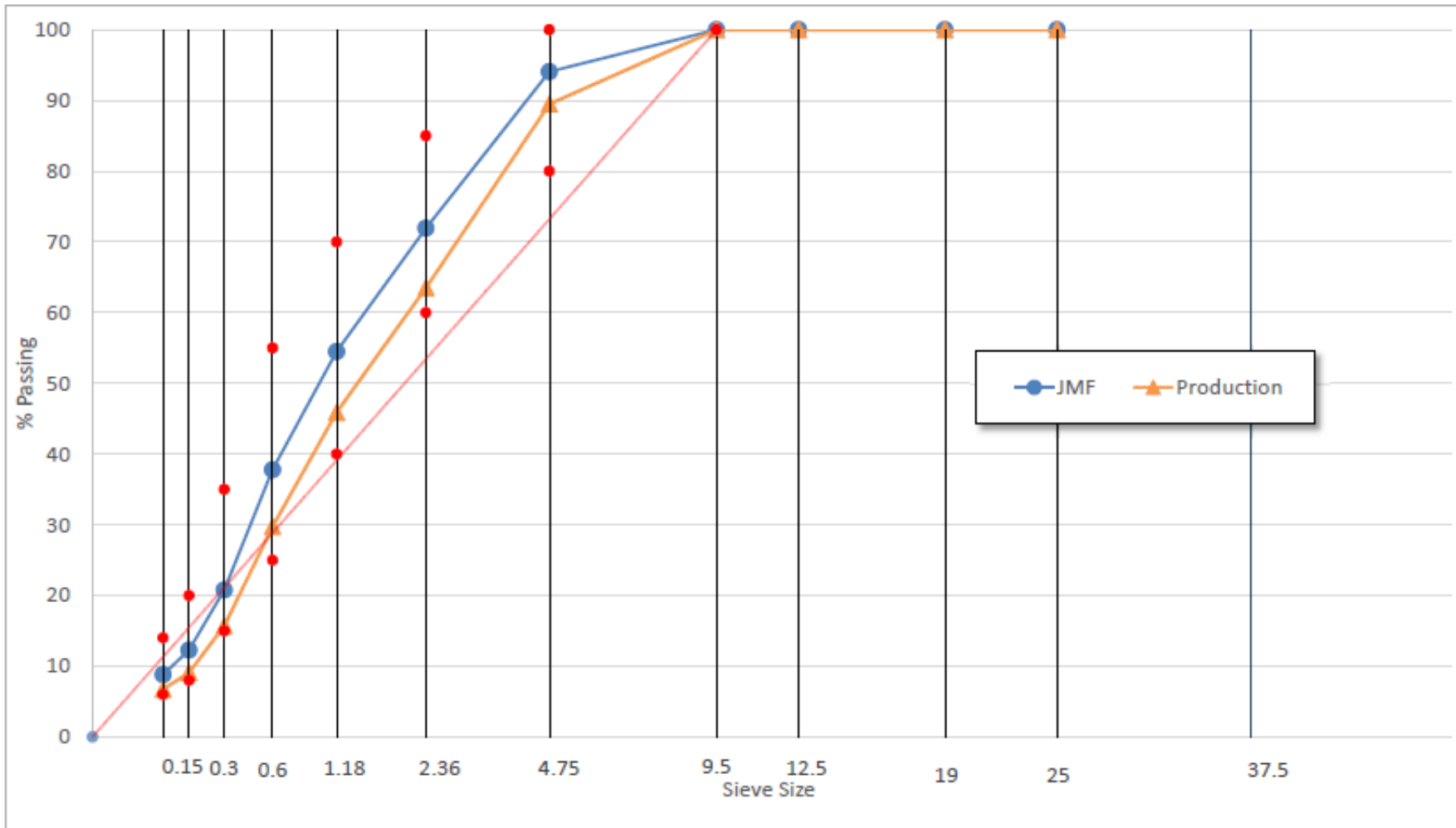
Dosing Equipment at Plant



- ▶ HSAI Production Rate = 130tph
- ▶ 130gt/aramid dose (2X)



JMF Gradation Curve



Optimum Mix Properties			
Property	Design	Production	Specification
Gyrations	50	50	50
Mixing Temp, °C	160		
Compaction Temp, °C	144	144	
AC Content, % by Total Wt of Mix	8.7	8.7	
Air Voids, %	1.5	1.4	0.5-2.5
VMA, %	19.6	22.3	> 16.0
VFA, %	92.6	93.7	
G _{se}	2.803	2.799	
G _{sb}	2.732	2.732	
Max. Sp. Gravity	2.440	2.436	
Bulk Sp. Gravity	2.405	2.401	
Unit Weight	150.1	149.8	
F/A Ratio	1.1	0.8	
HWT Passes @ 45°C	4,519	4,520	> 4,000
CT Index @ 19°C	584.6	416.3	> 300

DTI QC
Testing

8.72%, 8.64%
1.77%, 2.41%

Start of HSAI Placement



Start of HSAI Placement



Placing of Mat



Placing of Mat





Flushing is Good!!



PQI Non-nuclear Density Gauge



Flushing is Good!



HSAI Cores



Performance (so far)

- ▶ Not uncommon for an asphalt overlay on concrete to crack after the 1st winter
- ▶ No reflective cracking after 1st winter. Finish 2nd winter in 2026
 - ▶ Rte 8 had settlement at culverts, but no pavement cracking

Lessons Learn

- ▶ HSAI is a high AC mix
 - ▶ Can asphalt plant handle high AC volume?
 - ▶ May affect plant production speed
- ▶ Trial Sections prior to production
 - ▶ At least 1 working day prior to production
 - ▶ Allows for confirmation of plant mix volumetrics
 - ▶ Long enough to allow of multiple rollers to work
- ▶ AC Content Critical - unable to achieve density if too low
- ▶ Compaction is critical
 - ▶ Get the rollers on ASAP - thin section, cools quickly
 - ▶ PQI gauge preferable to NDG - allows for thin lift thickness

Lessons Learn (cont'd)

- ▶ **Geology Matters**
 - ▶ Original HSAI compacted with static rolling only.
 - ▶ These interlayers were developed where poor-quality aggregate was prone break down with vibration
 - ▶ Better quality aggregate in Canada allows for some vibration to start compaction process
- ▶ Once flushing is observed, density has been achieved

THANK YOU

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